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A PRELIMINARY STUDY ON METHANE DESORPTION OF SYDNEY COAL FROM DEVCO MINES

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Canadian Explosives Research Laboratory

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A PRELIMINARY STUDY ON METHANE DESORPTION OF SYDNEY COAL FROM DEVCO MINES

by

K.K. Feng*, K.C. Cheng** and R. Augsten†

ABSTRACT

For methane desorption tests, the direct method is used to determine the gas content in the rock strata and coal seams of Sydney coalfield at Cape Breton Island, Nova Scotia. The core samples used for methane desorption tests were obtained by drilling a downhole from a working level in the Harbour seam at Devco No. 26 Mine. Also the freshly cut run-of-mine coal samples were collected for desorption tests from a longwall face at Lingan Mine. The preliminary tests identified that the in situ methane content in the Sydney coalbeds is very high and that the broken coals release the gas slowly and retain the gas for several months before it is completely desorbed under the ambient temperature and pressure conditions.

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ÉTUDE PRÉLIMINAIRE SUR LA DÉSORPTION DU MÉTHANE DU CHARBON DE SYDNEY EXTRAIT DES MINES DEVCO

par

K.K. Feng*, K.C. Cheng** et R. Augsten†

RÉSUMÉ

Pour les essais de désorption du méthane, on détermine par la méthode directe la teneur en gaz de la strate rocheuse et des filons de charbon dans la couche de Sydney, à l'Île du Cap-Breton (Nouvelle-Écosse). Les carottes utilisées pour les essais ont été obtenues par un forage vers le bas à partir d'un niveau de travail dans le filon Harbour à la mine n° 26 de Devco. On a aussi recueilli des échantillons de minerai brut fraîchement extrait de la mine Lingan exploitée par longue tailles. Les essais préliminaires ont montré que la teneur in situ en méthane des filons de Sydney était très élevée et que l'anthracite de 60 à 100 mm libérait lentement le gaz. Avec ce charbon, la désorption complète du gas prend plusieurs mois dans les conditions ambiantes de température et de pression.

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INTRODUCTION

The coalification of plant materials in the sedimentary rock produces different ranks of coal and various mixtures of gases. The gas mixtures are retained in coalbeds and rock strata under the formation pressure. The amount of gas remaining in a coalbed varies considerably depending on the rank of coal and the depth of overburden. Generally, the desorption method or the so called direct method is used to determine the total volume of gases released from a coal sample after it has been isolated from a coalbed. The measured values of gas content in some of the North American coalbeds range from zero to about 20 cm^3 of methane per gram of coal (1,2).

Methane is released from coalbeds as mining progresses. Adequate ventilation is required to control the methane concentration in the air when mining the coal underground. The explosive range of methane gas in the air is between 5 and 15% by volume. When the coal dust is suspended in a methane-air mixture, the explosibility increases as the dust concentration increases (3). There have been incidents of gas and/or dust explosion at the longwall faces in Devco No. 26 Mine. The causes of ignition were identified to be the frictional sparks produced when the shearer struck the sandstone intrusion at the longwall face (4,5). The methane ignition initiated at the cutting head of the shearer drum has always been a major cause for gas explosion in a modern mechanized coal mine. Some ignitions are propagated and others are not.

The sources of methane emission in the mine are the broken coal, the working faces, the gob area, the coal pillars and the strata above and below the working seam. The major factor that dominates the rate of methane emission is the methane content in the coalbeds. The in situ methane content in the coalbeds of Sydney coalfield has never been determined. For a preliminary study, the direct method as described in reference (6) is used to determine the in situ methane content in the Phalen seam in an unmined area. The core samples were obtained for desorption tests by drilling a downhole from a working level in the Harbour seam to intersect the Phalen seam coal. Also the freshly cut run-of-mine (ROM) coal samples from the longwall faces were collected for desorption tests and the results are compared with the measured values of the in situ methane content. A better knowledge on methane sources and their emission characteristics will lead to a better control and prevention of gas explosions underground.

COAL SEAMS OF SYDNEY COALFIELD

The Sydney coalfield has twelve significant coal seams with thickness over 0.9 m and the sequence of coal seam depositions is shown in Fig. 1. Most coalbeds have the outcrops on or near the east coast of Cape Breton Island and are dipping seaward at less than 25° in the onshore area. The dip angles decrease gradually as the coal seams go deeper in the ocean. The slopes of the seabed in the same offshore area vary from 0.3° to 0.7°. Economically, the most important coalbeds in Sydney coalfield are the Lloyd Cove, Hub, Harbour and Phalen seams. Coal in Harbour and Phalen seams has been actively exploited for over two hundred years. The clay gashes or stone partings are commonly presented in the coal seams and create problems for mining as well as gas explosion (7,8,9).

Most of the Sydney coal is high volatile-A bituminous coal with the ash content ranging from 3 to 15% and the sulphur content from 1 to 6%. The metallurgical coal requires the sulphur content to be no more than 1% after washing. Raw coal with a sulphur content of less than 3% can be washed to upgrade to a metallurgical coal. The coal in the Harbour and Phalen seams is a major source of metallurgical coal. The methane content in the Sydney coal seams is anticipated high according to their coal ranks.

METHANE DESORPTION OF ROCK AND COAL SAMPLES FROM VERTICAL BOREHOLE

The in situ gas content in the coalbeds below the Harbour seam at No. 26 Mine area is considered undisturbed. Mining prior to 1943 at 1A and 1B mine areas was carried out in the Phalen seam from surface to a depth of about 200-250 m below sealevel. Since then the Harbour seam coal has been extracted leaving the Phalen seam coal intact. The core samples from the rock strata and coal seams were obtained for desorption tests by drilling a vertical borehole from the 12N coal level in the Harbour seam at No. 26 Mine. The drilling station was set up at about the mid-point on this coal level where the elevation is 670 m below sealevel and a diamond drill was used to recover the 6 cm core samples at various depths as shown in Table 1. The equipment used and the procedures for the methane desorption tests are described in reference (6). The results are summarized in Table 2 and the details of representative desorption data are listed in Appendix A.

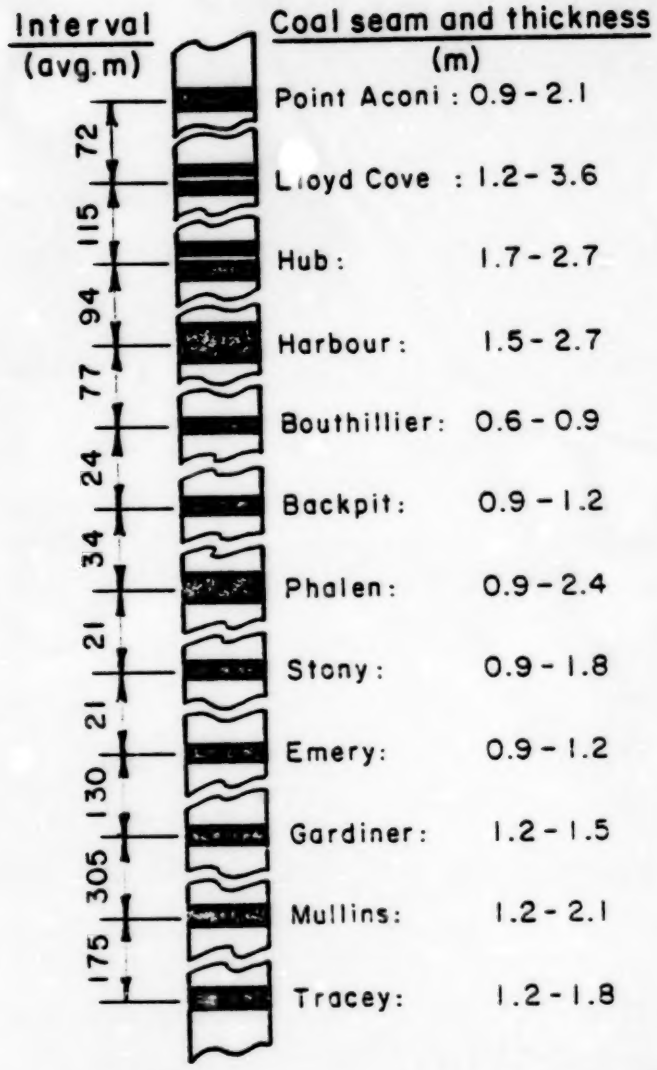

Fig. 1 - Sequence of coal seams in Sydney coalfield.

Table 1 - Section of strata showing locations of core samples taken for methane desorption test at Borehole-140 in No. 26 Mine

Sample No. and depth (No. - m)	Depth below Harbour seam m	Approx thickness of beddings Feet	Metre	Nature of strata
		55	16.8	Interbands of shale and sandstone
		13	4.0	Sandstone-medium grain
		15	4.6	Shale-dark grey
		7	2.1	Harbour seam coal
	12.0	39.5	12.0	Shale-interbandings of sandy shale and grey shale
	12.2	0.6	0.2	Coal-dirty
	31.4	63	19.2	Shale-interbandings of light and dark grey shales
	40.6	30	9.2	Sandy shale or siltstone
	47.6	23	7.0	Sandstone-medium grain
	50.3	9	2.7	Shale-interbands
	50.6	1	0.3	Coal-dirty
	62.2	38	11.6	Shale-dark grey, fine grain
2-71.0	72.0	32*	9.8	Sandy shale or siltstone
3-77.1	80.5	28*	8.5	Shale-dark grey, with sandstone bands
4-80.2	81.4	3	0.9	Bouthillier seam coal
5-82.9	101.8	67*	20.4	Interbands of shale and sandy shale with 3" coal
6-101.2	102.4	2*	0.6	Backpit seam coal
7-102.1	104.9	8	2.5	Shale and sandy shale
8-106.6	108.6	12*	3.7	Sandstone-fine to medium grain, carbonaceous laminations

* indicates core samples taken for desorption test

Table 1 - (cont'd)

Sample No. and depth (No. - m)	Depth below Harbour seam m	Approx thickness of beddings Feet	Metre	Nature of strata
	114.1	18	5.5	Shale-interbands
	129.3	50	15.2	Sandstone-fine to medium grain with bands of shale
9-132.6	133.1	12.5*	3.8	Shale-grey, sandy laminations
10-134.1	134.8	5.5*	1.7	Shale-carbonaceous, dark grey
11-135.4	136.9	7*	2.1	Phalen seam coal
12-136.6	152.1	50	15.2	Shale-interbands of light to dark grey shales
	157.1	16.5	5.0	Sandstone-medium grain, light grey, coaly streaks

* indicates core samples taken for desorption test

The total gas content in a coalbed sample includes the lost gas (Q_1), desorbed gas (Q_2) and residual gas (Q_3). After a core sample is separated from a coal seam, the sample starts to give off gases before it is sealed in the desorption bottle. The amount of gas lost during this time is called "lost gas" and it can be estimated by a graphical method using the first two hour readings of Q_2 measurements. The "desorbed gas" is the volume of gas released and measured while the core sample is in the sealed bottle. The desorption test of Q_2 is stopped when the gas emission rate decreases to less than 0.05 $cm^3/g/day$ for several consecutive days. Then the sample is removed from the desorption bottle and dried at room temperature before a final test for the "residual gases". The residual gas (Q_3) is the volume of gas liberated by crushing and grinding the coal sample to a fine powder below 200 mesh. All the gases released are measured with the desorption apparatus.

METHANE DESORPTION OF ROM COAL SAMPLES FROM LONGWALL FACE

Generally, the coal seam of Sydney coalfield at a depth over 300 m below sealevel is extracted with the advancing longwall method. A longwall block is developed by driving along the strike of coalbed two separate access

Table 2 - Summary of methane desorption of core samples from Borehole-140
(vertical borehole drilled downward from 12N coal level at No. 26 Mine)

Sample No.	Core sample	Depth below Harbour seam m	Lost gas (Q_1) cm^3/g	Desorbed gas (Q_2) cm^3/g	Residual gas (Q_3) cm^3/g	Total gas cm^3/g	Q_1/Q %	Q_3/Q %
2	Siltstone-laminated	71.0		0.211				
3	Shale-massive, grey	77.1		0.023				
4	Shale-carbonaceous	80.2		0.209				
-	Boutillier seam (0.9 m of coal lost when drilling through the Boutillier seam)							
5	Shale-fragmental	82.9		0.041				
6	Shale-laminated	101.2		0.067				
7	Backpit seam coal	102.1	0.602	3.239	1.423	5.264	11.4	27.0
8	Sandstone-fine grain	106.6		0.143				
9	Shale-compact, grey	132.6		0				
10	Shale-compact, grey	134.1		0				
11	Phalen seam coal	135.4	0.966	7.795	2.143	10.904	8.9	19.6
12	Phalen seam coal	136.6	0.465	8.307	2.312	11.084	4.2	20.9

levels, one as the top level and the other as bottom level, then a mining face or wall is established between the two levels at a distance of 182-213 m on the incline. The top level called material level is used as an access for supplying the materials to the face and also used as a return airway. The bottom level called coal level is used as a roadway for conveying the coal from the wall out to the slope and also used as an intake airway. The rib pillar between the two longwall blocks is maintained 46 to 92 m wide as a barrier according to the depth and ground conditions. The shearer with double-ended ranging drums is used to cut the coal along the wall. The belt conveyors, electric locomotive haulage and skip hoist are used at various locations to transport the coal to surface. While the coal is in transit, the methane is released from the coal piles into the mine air. The rate of methane emission from the ROM coal varies with the resident time of the coal staying in the mine. The methane emission rate and the desorption characteristic of Sydney coal was studied by using the freshly cut coal samples by shearer at 6E longwall face in Lingan Mine. The shearer cuts approximately 72 cm deep into the coal and runs a full height at the coal face. All samples were collected within 15 min after the shearer had passed the sampling locations and the lost gas time for most samples is within 25 min. The equipment used and the procedures for methane desorption tests are described in reference (6). A summary of the test result is shown in Table 3. Sample No. 1 was collected during the first cut, No. 3 and No. 4 the second cut, No. 5 and No. 6 the third cut, No. 7 and No. 8 the fourth cut at 6E longwall face in Lingan Mine. Sample No. 10 was collected from a stage-loader at 13N longwall face in No. 26 Mine. The details of the typical desorption data are shown in Appendices B and C.

RESULTS AND DISCUSSION

The in situ methane contents in the rock strata and coal seams below the Harbour seam coal were measured and the results are shown in Table 2 and Fig. 2, 3 and 4. The analysis of Borehole-140 coal samples is shown in Table 4. The methane contents in the shale and sandstone beds are very low. The total gas content in the Phalen seam is 11 cm^3/g at a depth 806 m below sea-level, that represents a reasonable value and agrees with other indications

Table 3 - Summary of methane desorption of 6E face samples from Lingan mine

Sample No.	Sample weight g	Lost gas (Q_1) cm^3/g	Cumulative desorption gas (Q_2) in cm^3/g						Residual gas (Q_3) cm^3/g	Total gas (Q) cm^3/g
			1 hour	1 day	10 days	30 days	90 days	±190 days		
1	535	0.110	0.134	0.907	2.589	3.746	4.950	5.337 (126 d)	1.567	7.014
3	526	0.072	0.088	0.697	1.402	1.755	2.394	3.434 (188 d)	0.931	4.497
4	608	0.101	0.113	0.983	2.583	3.791	4.468 (53 d)		N.A.	-
5	600	0.072	0.096	0.816	2.442	3.954	5.236	6.004 (188 d)	1.310	7.386
6	494	0.098	0.114	0.805	1.726	2.412	2.765 (53 d)		N.A.	-
7	626	0.096	0.176	1.070	2.759	3.909	4.802	5.218 (192 d)	1.333	6.647
8	594	0.104	0.125	0.984	2.584	3.778	4.924	5.941 (192 d)	0.892	6.937
10*	682	0.113	0.215	1.051	3.402	4.542	5.506	6.108 (187 d)	0.809	7.030

* Sample No. 10 was collected from 13N longwall face at No. 26 Mine

Table 4 - Analysis of Borehole-140 coal samples

(A) Proximate analysis - as received in %

Sample No.	Coal seam	Moisture	Ash	Volatile matter	Fixed carbon (by difference)
7	Backpit	0.66	35.28	22.56	41.50
11	Phalen	0.80	3.27	28.99	66.94
12	Phalen	0.92	1.95	28.23	68.90

(B) Ultimate analysis - as received in %

Sample No.	Moisture	Ash	C	H_2	S	N_2	O_2 (by diff)
7	0.66	35.28	52.73	3.44	5.35	1.08	1.46
11	0.80	3.27	83.46	5.30	1.95	1.55	3.67
12	0.92	1.95	85.11	5.36	0.80	1.73	4.13

for a high gas content in the Sydney coalbeds. The measured value of gas content for the Backpit seam coal sample is not a representative value because of a high ash content in this sample. The emission characteristic of methane desorption curves for the Phalen seam coal is quite different from that for the Greenhills coal of Fording Coal Ltd. in British Columbia. The Greenhills coal releases the gases more easily and gives off a major portion of the total gas during the first day after the sample is isolated from the coalbed (2). Whereas the Phalen seam coal of Devco mines releases the gas slowly and retains the gas for a longer period before it is completely desorbed under the ambient temperature and pressure conditions.

The gas contents in the freshly cut ROM coal samples from the longwall face in Lingan Mine were measured and the results are shown in Table 3 and Fig. 5 and 6. The analysis of 6E face samples of Harbour seam coal is shown in Table 5. The total gas content in the Harbour seam coal of the face samples is 7 cm^3/g at a mining depth of (500 ±15) m below sealevel. It indicates that the majority of the in situ methane gas in the Harbour seam is not

Table 5 - Analysis of 6E face samples of Harbour seam coal

(A) Proximate analysis - as received in %

Sample No.	Moisture	Ash	Volatile matter	Fixed carbon (by difference)
1	2.01	4.04	37.13	56.82
3	1.36	4.71	36.32	57.61
5	1.33	3.39	37.18	58.10
7	1.32	8.92	34.81	54.95
8	1.30	7.40	34.59	56.71

(B) Ultimate analysis - as received in %

Sample No.	Moisture	Ash	C	H_2	S	N_2	O_2 (by diff)
1	2.01	4.04	76.73	4.84	2.32	1.98	8.08
3	1.36	4.71	78.29	4.98	2.32	1.82	6.52
5	1.33	3.39	79.27	5.19	2.73	1.95	6.14
7	1.32	8.92	74.35	4.86	3.03	1.78	5.74
8	1.30	7.40	75.29	4.96	3.15	1.88	6.02

being released until the coal is excavated. The gas content of the face samples correlates well with its ash content but poorly with the horizontal distance from a mining face. Generally, the gas content of a face sample is inversely proportional to its ash content. Figure 5 shows the emission characteristic curves for the face samples with ash contents between 3.4 and 8.9%. The broken coal samples release methane gas slowly and detain the gas for several months before it is completely desorbed under the ambient temperature and pressure conditions.

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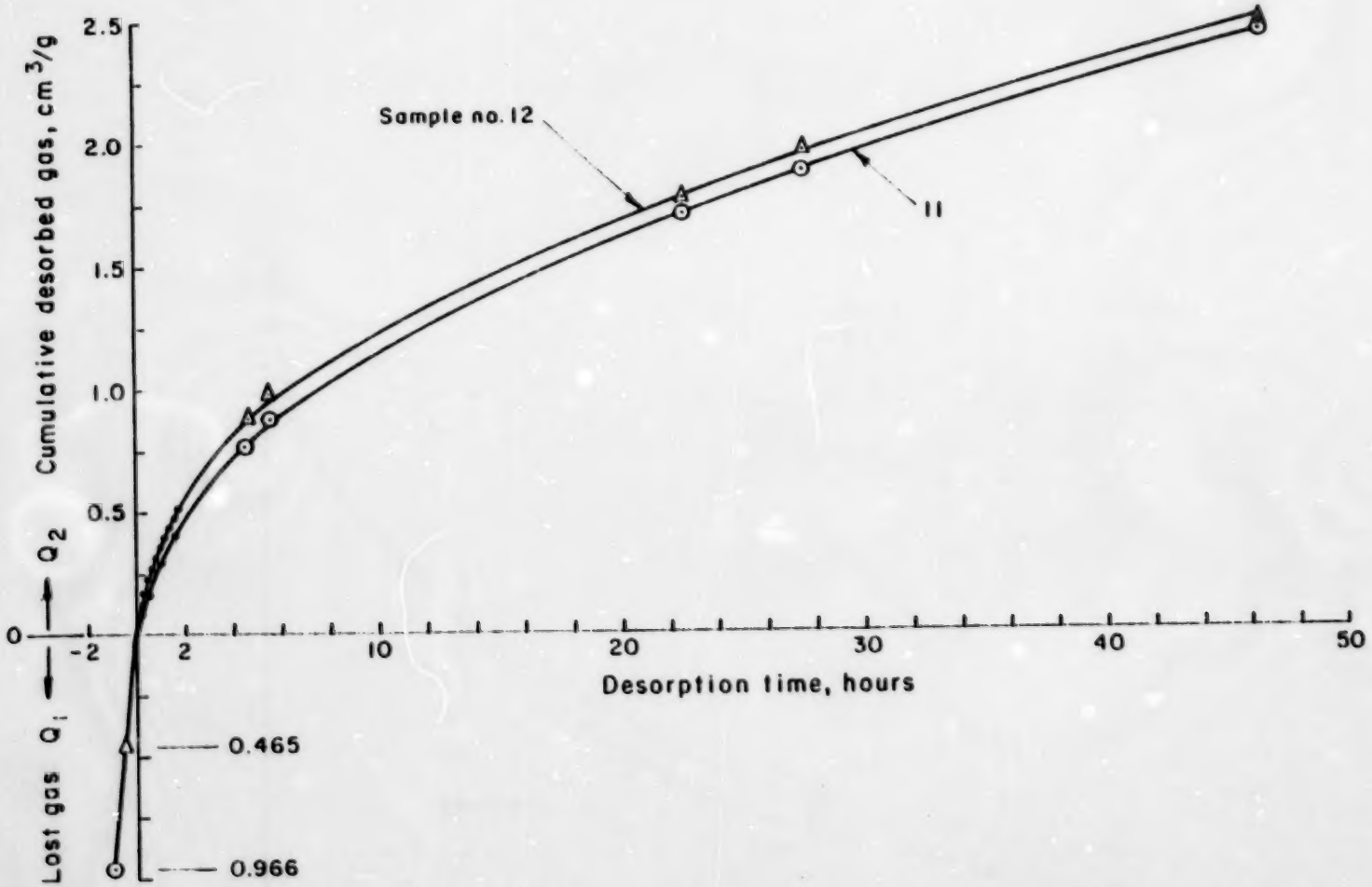

Fig. 2 - Short-term methane desorption curves for Borehole-140 coal samples.

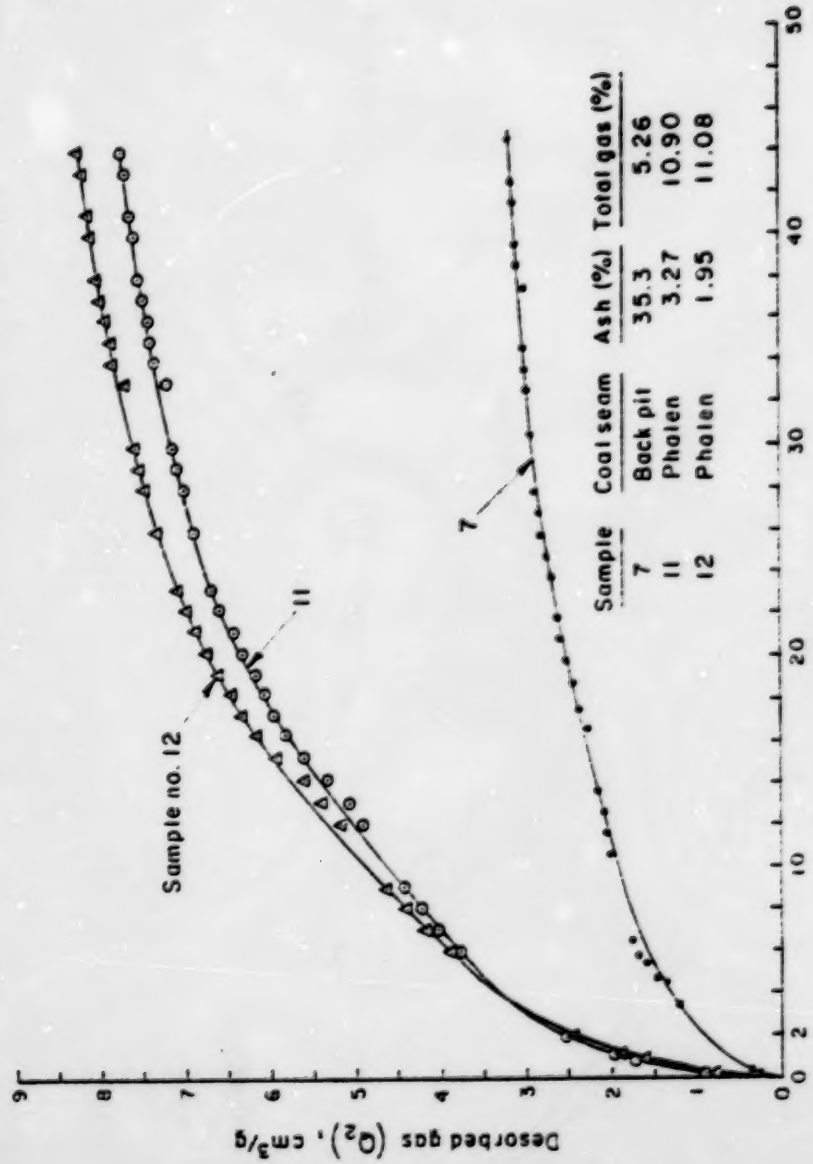
Desorbed gas (Q_2), cm³/g
Desorption time, days
Sample no. 12
11
7
Sample | Coal seam | Ash (%) | Total gas (%)
7 | Back pit | 35.3 | 5.26
11 | Phalen | 3.27 | 10.90
12 | Phalen | 1.95 | 11.08

Fig. 3 – Long-term methane desorption curves for Borehole-140 coal samples.

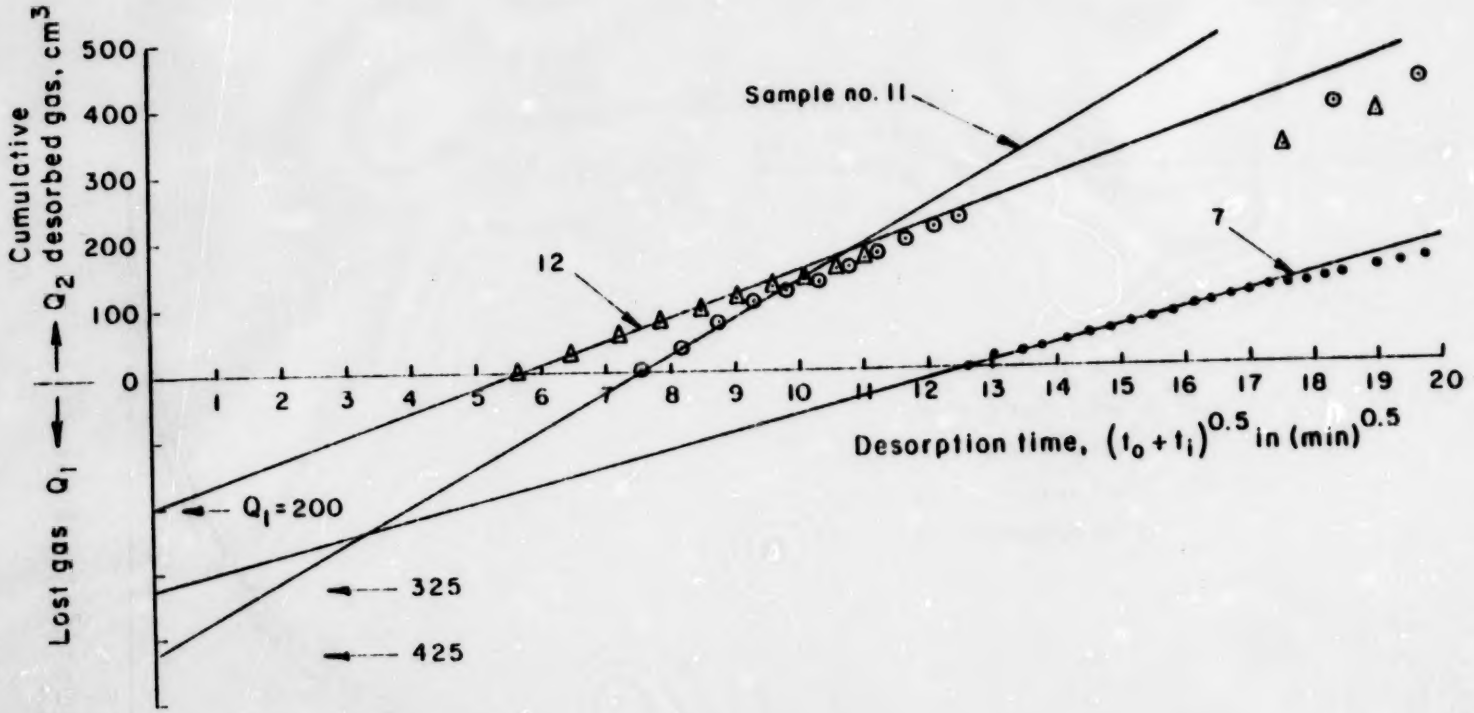

Fig. 4 - Estimate of lost gas for Borehole-140 coal samples

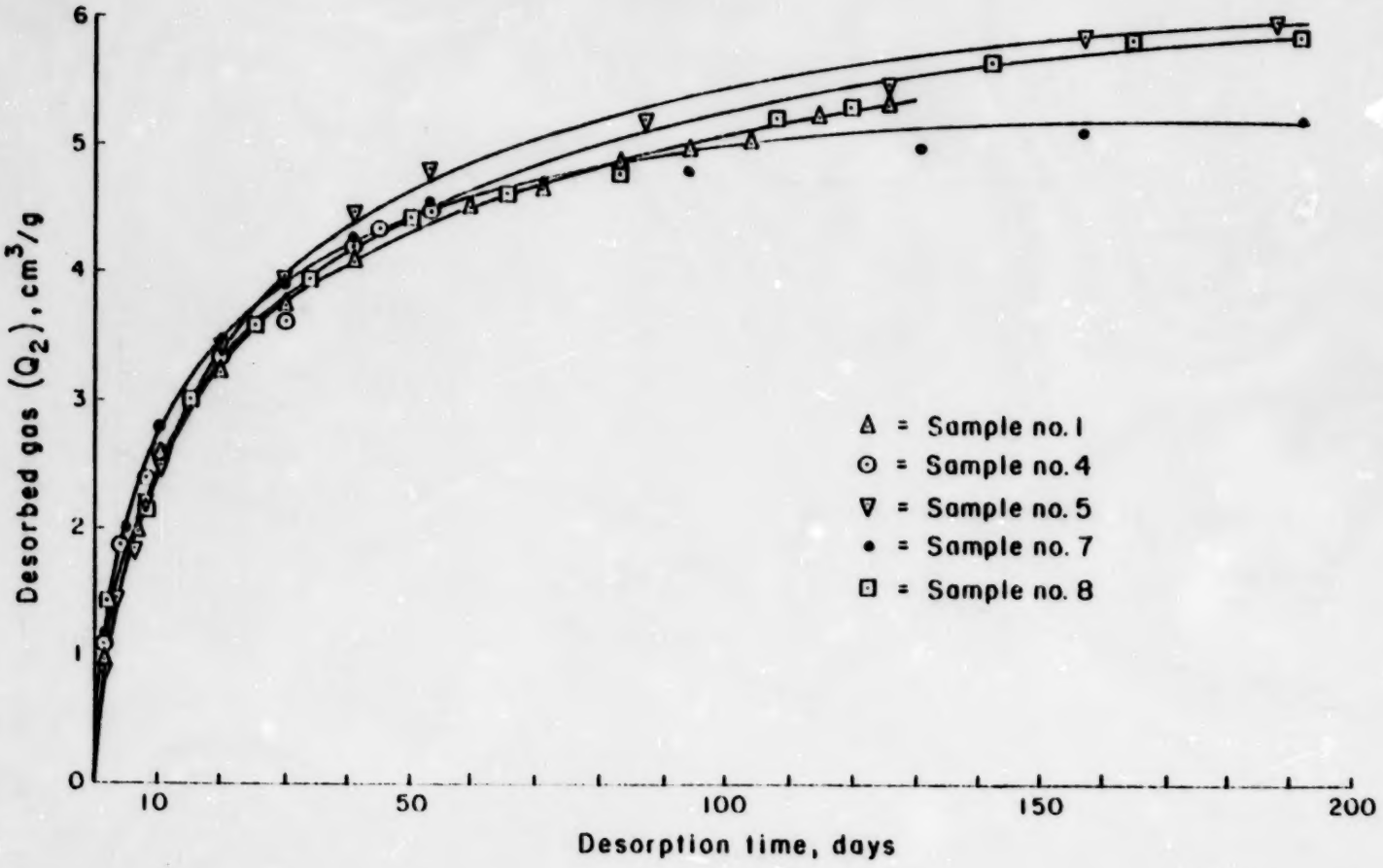

Fig. 5 - Methane desorption curves for ROM coal samples from 6E longwall face at Lingan Mine.

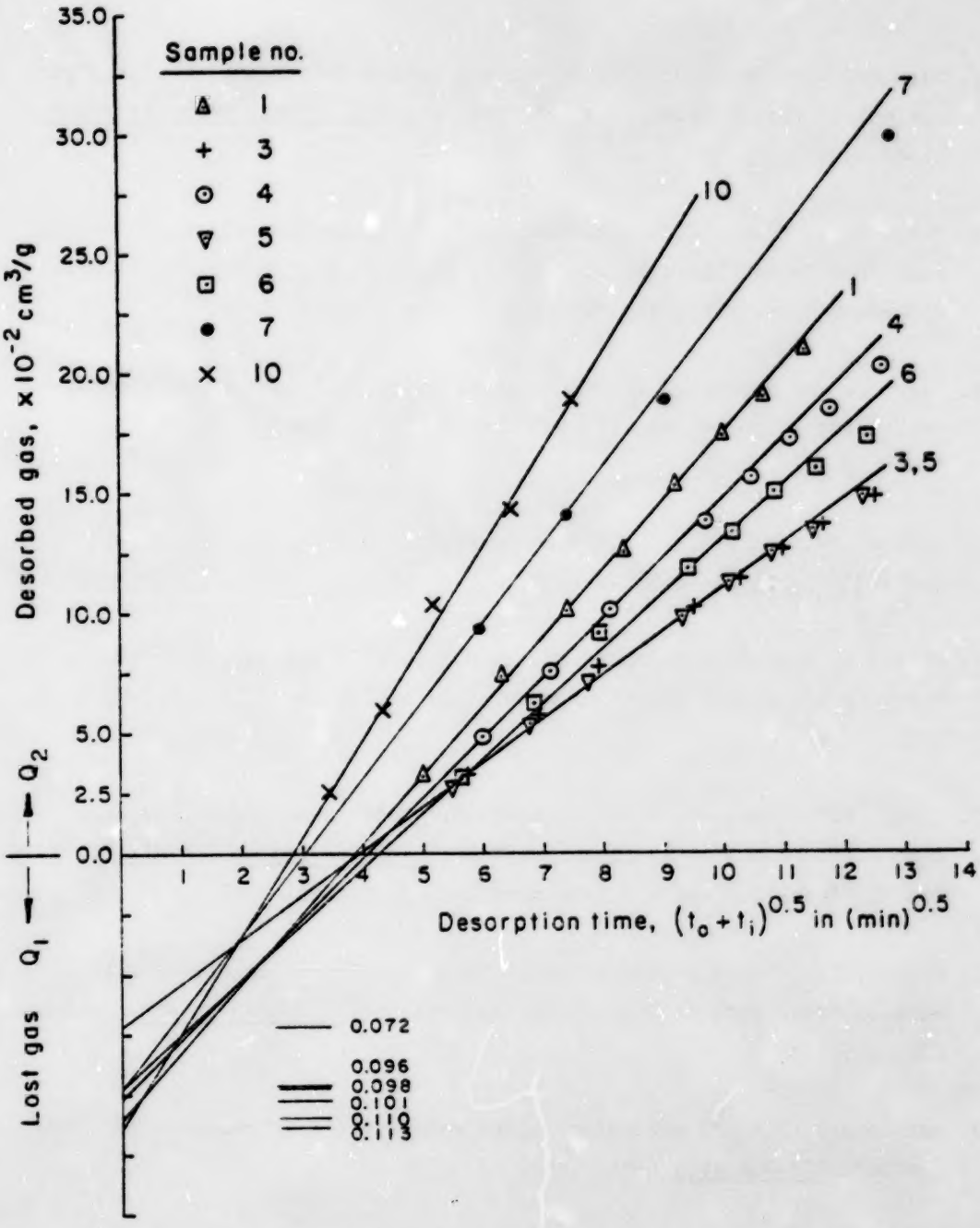

Fig. 6 - Estimate of lost gas for ROM coal samples from Lingan 6E longwall face.

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APPENDIX A

Desorption data of Phalen seam coal core sample from strata below No. 26 Mine

DATE: Oct. 15 - Dec. 1, 1980

COMPANY DRILL HOLE NO.: B-140, No. 26 Mine, Devco

SAMPLE NO: 11 COALBED: Phalen seam

CONDITION OF SAMPLE: solid core CORE SIZE: 6.0 cm SAMPLE WEIGHT: 440 g

DEPTH OF CORE: 135.3-135.6 m below Harbour seam on 12N coal level

ELEVATION OF DRILL STATION: 670 m below sealevel

CORING START: From 0:800 To 08:25 CORE RETRIEVING: From 08:55 to 09:00

CORE SEALING TIME: 09:10 LOST GAS TIME: 57 min

Time after sealing	Desorbed gas (Q_2) - cm^3			Ambient pressure	Ambient temperature	Factor	Cum gas content at STP
	Increment	Vol at STP	Cum STP vol				
Day-Hr-Min				kPa	°C		cm^3/g
00-00-10	38.0	33.0	33.0	96.4	26	0.869	0.075
00-00-20	46.0	40.0	73.0	"	"	"	0.166
00-00-30	35.2	30.6	103.6	"	"	"	0.235
00-00-40	16.5	14.3	117.9	"	"	"	0.268
00-00-50	21.5	18.7	136.6	"	"	"	0.310
00-01-00	22.0	19.1	155.7	96.5	"	0.870	0.354
00-01-10	22.5	19.6	175.3	"	"	"	0.398
00-01-20	21.5	18.7	194	"	"	"	0.441
00-01-30	21.0	18.3	212.3	"	"	"	0.483
00-01-40	16.0	13.9	226.2	"	"	"	0.514
		Sample shipping from underground to surface					
00-04-40	177.4	165.6	391.8	102.2	22	0.934	0.890
00-05-31	42.2	39.4	431.2	"	"	"	0.980
00-22-36	370.6	349.4	780.6	103.2	"	0.943	1.774
01-03-36	91.8	86.5	867.1	"	"	"	1.971
01-22-22	245.2	230.3	1097.4	102.8	"	0.939	2.494
		Sample shipping from Glace Bay to Ottawa					
06-00-05	599.0	552.4	1649.8	100.6	21	0.922	3.750
06-23-35	131.8	123.0	1772.8	101.8	"	0.933	4.029
07-23-30	86.4	83.0	1855.8	104.5	20	0.961	4.218
09-00-35	96.0	92.0	1947.8	"	21	0.958	4.427
11-22-55	220.0	208.1	2155.9	102.5	19	0.946	4.900
12-23-20	97.7	91.7	2247.6	102.1	20	0.939	5.108
14-04-30	93.1	87.3	2334.9	103.0	23	0.938	5.307

APPENDIX A (cont'd)

Readings below are described in the bath of controlled temperature

15-05-50	129.6	119.8	2454.7	103.2	28	0.924	5.579
16-06-27	105.6	95.5	2550.2	101.0	"	0.904	5.796
17-06-35	66.7	61.1	2611.3	102.0	27	0.916	5.935
18-07-25	50.4	46.8	2658.1	103.4	"	0.929	6.041
19-06-32	58.1	53.6	2711.7	102.7	"	0.923	6.163
20-06-30	76.8	69.4	2781.1	100.9	28	0.903	6.321
21-06-35	47.0	43.0	2824.1	101.8	27	0.914	6.418
22-05-30	83.1	75.7	2899.8	101.1	26	0.911	6.590
23-06-35	50.9	46.1	2945.9	100.8	27	0.905	6.695
25-23-10	92.4	84.1	3030	101.3	"	0.910	6.886
27-23-10	56.9	52.5	3082.5	103.1	28	0.923	7.006
28-23-20	37.4	34.6	3117.1	103.2	"	0.924	7.084
29-23-05	36.2	33.2	3150.3	102.5	"	0.918	7.160
32-23-22	25.7	24.0	3174.3	104	27	0.934	7.214
33-23-00	66.7	60.8	3235.1	102.1	29	0.911	7.353
34-23-00	23.3	21.4	3256.5	103.1	"	0.920	7.401
35-23-10	9.6	8.9	3265.4	103.2	28	0.924	7.421
36-23-10	35.5	32.5	3297.9	102.6	29	0.916	7.495
38-00-10	21.6	19.8	3317.7	103.3	30	0.919	7.540
39-23-10	31.2	28.7	3346.4	102.9	28	0.921	7.605
40-23-10	11.0	10.1	3356.5	102.7	"	0.920	7.628
41-23-08	-0.5	-0.5	3356	103.9	27	0.933	7.627
42-23-10	33.4	30.9	3386.9	"	30	0.924	7.698
43-23-10	29.8	27.0	3413.9	102	"	0.907	7.759
46-23-10	17.5	16.0	3429.9	"	28	0.913	7.795

APPENDIX B

Desorption data of Harbour seam coal face sample from Lingan Mine

DATE: Nov. 20/79 to May 28/80

COMPANY: DEVCO

LOCATION: 6E longwall face, Lingan Mine

SAMPLE NO.: 5

COALBED: Harbour Seam

CONDITION OF SAMPLE: Broken coal cut by shearer

SIZE: lump coal reduced to -6 cm

DEPTH OF WORKING FACE: (500 ±15)m below sealevel

COAL CUTTING AT: 11:21, Nov. 20/79

COAL SEALING AT: 11:36

LOST GAS TIME: 15 min

SAMPLE WEIGHT: 599.5 g

Time after sealing	Desorbed gas (Q_2) - cm^3			Ambient pressure	Ambient temperature	Factor	Cum gas content at STP
	Increment	Vol at ST	Cum STP vol				
Day-Hr-Min				kPa	°C		cm^3/g
00-00-05	17.5	15.9	15.9	99.0	20	0.911	0.027
00-00-20	18.6	17.0	32.9	"	"	"	0.055
00-00-35	14.0	12.8	45.7	"	"	"	0.076
00-01-02	14.3	13.0	58.7	"	"	"	0.098
00-01-17	9.7	8.8	67.5	"	"	"	0.113
00-01-32	7.9	7.2	74.7	"	"	"	0.125
00-01-47	6.1	5.6	80.3	"	"	"	0.134
00-02-08	9.0	8.2	88.5	"	"	"	0.148
			Sample shipping from underground to surface				
00-03-48	70.2	65.1	153.6	101.5	22	0.927	0.256
00-10-15	208.6	193.4	347.0	"	"	"	0.579
01-06-06	222.4	206.2	553.2	"	"	"	0.923
02-10-06	210.6	195.5	748.4	"	"	"	1.248
03-09-08	150.0	139.1	887.5	"	"	"	1.480
04-08-07	94.8	87.9	975.4	"	"	"	1.627
			Sample shipping from Grace Bay to Ottawa				
06-04-11	139.0	129.2	1104.6	102.0	23	0.929	1.843
07-04-31	117.0	108.7	1213.3	"	"	"	2.024
08-05-16	129.5	120.3	1333.6	"	"	"	2.225
09-05-16	109.5	101.8	1435.4	102.1	"	0.930	2.394
10-04-51	40.1	37.3	1472.7	102.2	"	0.923	2.457
13-02-53	236.5	219.7	1692.4	102.0	"	0.929	2.823
15-05-18	147.4	137.3	1829.7	"	22	0.932	3.052
17-05-25	125.3	118.3	1948.0	103.4	"	0.944	3.249
20-05-06	78.9	74.2	2022.2	103.0	"	0.941	3.373
23-05-09	151.3	143.1	2165.3	104.0	23	0.946	3.612
26-06-45	114.3	107.8	2273.1	103.4	"	0.943	3.792
30-04-36	111.1	104.2	2377.3	101.8	20	0.938	3.965
33-06-29	110.9	104.1	2481.4	103.2	22	0.939	4.139
37-00-09	84.8	78.0	2559.4	101.0	23	0.920	4.269

APPENDIX B (cont'd)

41-01-17	139.4	128.5	2687.9	"	22	0.922	4.484
45-05-41	98.2	91.4	2779.3	102.2	"	0.931	4.636
48-00-23	46.7	44.3	2823.6	102.8	19	0.949	4.710
53-02-36	74.7	69.5	2893.1	101.6	21	0.930	4.826
57-04-52	75.0	70.2	2963.3	103.3	23	0.936	4.943
66-02-48	79.6	73.7	3037.0	101.0	"	0.926	5.066
71-04-54	35.3	33.0	3070.0	102.0	24	0.935	5.121
83-01-06	27.4	25.4	3095.4	101.8	23	0.927	5.163
87-00-44	37.2	34.5	3129.9	"	"	"	5.221
94-04-54	30.0	28.4	3158.3	104.0	"	0.947	5.268
108-04-17	19.5	18.0	3176.3	102.5	22	0.923	5.298
115-04-18	50.5	45.7	3222.0	101.0	26	0.905	5.374
121-20-58	38.2	34.9	3256.9	100.9	"	0.914	5.433
128-20-57	56.8	52.5	3309.4	103.3	25	0.924	5.520
135-00-07	50.2	46.4	3355.8	102.4	23	"	5.598
143-03-49	63.5	59.0	3414.8	102.2	24	0.929	5.696
148-02-11	33.3	30.7	3445.5	100.5	22	0.922	5.747
157-00-00	75.3	69.6	3515.1	101.6	25	0.924	5.863
164-23-09	34.9	32.3	3547.4	101.7	23	0.926	5.917
188-02-29	56.5	52.1	3599.5	100.2	22	0.922	6.004

APPENDIX C

Desorption data of Harbour seam coal face sample from No. 26 Mine

DATE: Nov. 21/79 to May 26/80

COMPANY: DEVCO

LOCATION: 13N longwall face, No. 26 Mine

SAMPLE NO.: 10

COALBED: Harbour Seam

CONDITION OF SAMPLE: Broken coal cut by shearer

SIZE: lump coal reduced to -6 cm

DEPTH OF WORKING FACE: (720 ±15)m below sealevel

COAL CUTTING AT: 10:12, Nov. 21/79

COAL SEALING AT: 10:22

LOST GAS TIME: 10 min

SAMPLE WEIGHT: 682 g

Time after sealing	Desorbed gas (Q_2) - cm^3			Ambient pressure	Ambient temperature	Factor	Cum gas content at STP
	Increment	Vol at STP	Cum STP vol	kPa	°C		cm^3/g
Day-Hr-Min							
00-00-02	19.4	16.9	16.9	96.5	25	0.873	0.025
00-00-17	61.5	53.7	70.6	"	"	"	0.104
00-00-32	30.7	26.8	97.4	"	"	"	0.143
00-00-47	35.2	30.7	128.1	"	"	"	0.188
		Sample shipping from underground to surface					
00-06-32	287.5	269.2	397.3	102.5	22	0.936	0.583
01-11-29	565.0	529.1	926.4	"	"	"	1.358
02-10-32	363.0	339.9	1266.3	"	"	"	1.857
03-09-27	242.0	226.6	1492.9	"	"	"	2.189
		Sample shipping from Grace Bay to Ottawa					
05-06-34	254.3	236.2	1729.1	102.0	23	0.929	2.535
06-06-02	155.0	144.0	1873.1	"	"	"	2.746
07-06-46	160.6	149.2	2022.3	"	"	"	2.965
08-06-38	143.5	133.3	2155.6	"	"	"	3.161
09-06-14	101.0	93.8	2249.4	"	"	"	3.298
12-05-00	221.8	206.0	2455.4	"	"	"	3.600
13-06-34	82.2	76.3	2531.7	"	"	"	3.712
14-06-36	37.6	34.7	2566.4	100.7	21	0.923	3.763
15-06-38	55.4	52.3	2618.7	103.4	22	0.945	3.840
16-06-51	50.2	47.4	2666.1	"	"	"	3.909
19-06-29	83.0	78.1	2744.2	103.0	"	0.941	4.024
20-06-31	63.5	60.0	2804.2	"	"	"	4.112
21-06-30	49.6	47.0	2851.2	104.0	23	0.947	4.181
23-06-27	78.9	74.7	2925.9	"	"	"	4.290
26-06-00	79.5	74.8	3000.7	103.4	"	0.941	4.400
29-05-54	78.0	73.0	3073.7	101.8	20	0.936	4.507
32-07-52	99.2	93.1	3166.8	102.2	21	0.938	4.643
36-00-31	64.8	59.7	3226.5	101.0	23	0.921	4.731
40-02-37	113.2	104.6	3331.1	"	22	0.924	4.884

APPENDIX C (cont'd)

44-05-58	73.2	68.1	3399.2	102.2	"	0.930	4.984
52-03-55	73.4	68.7	3467.9	102.0	21	0.936	5.085
58-06-09	79.1	73.9	3541.8	103.3	"	0.934	5.193
65-04-27	79.0	73.0	3614.8	101.0	20	0.924	5.300
70-06-12	30.4	28.4	3643.2	102.8	24	0.934	5.342
82-05-04	61.2	56.7	3699.9	101.8	23	0.927	5.425
86-02-04	37.6	34.8	3734.7	"	"	"	5.476
93-06-12	40.2	38.1	3772.8	104.0	"	0.947	5.532
103-06-28	40.5	38.2	3811.0	103.6	"	0.943	5.588
114-06-36	98.5	89.2	3900.2	101.0	26	0.906	5.719
121-00-00	65.5	60.2	3960.4	101.5	25	0.919	5.807
131-00-00	52.7	48.7	4009.1	102.4	26	0.924	5.878
142-05-06	58.7	54.4	4063.5	102.1	24	0.927	5.958
152-00-00	64.6	59.7	4123.2	102.5	25	0.924	6.046
164-00-28	32.5	30.0	4153.2	101.7	23	0.923	6.090
187-03-53	12.0	11.0	4164.2	100.2	21	0.918	6.106
194-00-00	2.0	1.8	4166.0	99.9	19	0.922	6.109